

**Claims:**

1. A method of processing a cracked gas feed stream containing hydrogen, methane, ethylene, propylene and other C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub>, C<sub>6</sub> and heavier unsaturated hydrocarbons to separate said ethylene and propylene from at least some of said other unsaturated hydrocarbons and to hydrogenate at least some of said other unsaturated hydrocarbons without hydrogenating ethylene and propylene comprising the steps of:

- a. introducing said feed stream into a first column comprising a catalytic distillation hydrogenation column containing at least one catalyst bed and containing fractionation zones and operating at a first pressure and concurrently:
  - (i) selectively hydrogenating at least a portion of said other unsaturated hydrocarbons without hydrogenating said ethylene and propylene;
  - (ii) separating by fractional distillation the resulting hydrocarbon mixture into a first column gross overhead stream containing unreacted hydrogen, methane, ethylene, propylene and C<sub>4</sub> and C<sub>5</sub> compounds and a first bottoms stream containing primarily C<sub>6</sub> and heavier hydrocarbons and some C<sub>5</sub>, C<sub>4</sub>, C<sub>3</sub> and C<sub>2</sub> unsaturated hydrocarbons; and
  - (iii) operating said first column so as to maintain said first bottoms stream at a temperature less than 200°C;
- b. separating said first column gross overhead stream into a first column net overhead stream and a first

- column reflux stream and introducing said first column reflux stream back into said first column;
- c. introducing said first bottoms stream from said first column into a second column comprising a fractionation column operating at a second pressure lower than said first pressure and separating said first bottoms stream into a net bottoms stream containing C<sub>6</sub> and heavier hydrocarbons and a selected amount of C<sub>5</sub> hydrocarbons and into a second column gross overhead stream containing primarily additional C<sub>6</sub> and heavier hydrocarbons, and C<sub>5</sub>, C<sub>4</sub>, C<sub>3</sub> and C<sub>2</sub> hydrocarbons and operating said second column so as to maintain said net bottoms stream at a temperature less than 200°C;
  - d. separating said second column gross overhead stream into a second column net overhead stream and a second column reflux stream and introducing said second column reflux stream back into said second column; and
  - e. recycling said second column net overhead stream to said first column.
2. A method as recited in claim 1 wherein the temperature of said first bottoms stream and said net bottoms stream are less than 160°C.
3. A method as recited in claim 1 wherein said first and second columns are operated as depentanizers and said selected amount of C<sub>5</sub> hydrocarbons in said net bottoms stream from said second column is less than 1%.

4. A method as recited in claim 3 wherein said first column is operated at a pressure in the range of 14 to 20 kg/cm<sup>2</sup> and said second column is operated at a pressure in the range of 4 to 10 kg/cm<sup>2</sup>.
5. A method as recited in claim 1 wherein said first and second columns are operated as debutanizers and said selected amount of C<sub>4</sub> hydrocarbons in said net bottoms stream is less than 1%.
6. A method as recited in claim 5 wherein said first column is operated at a pressure in the range of 28 to 43 kg/cm<sup>2</sup> and said second column is operated at a pressure in the range of 5 to 14 kg/cm<sup>2</sup>.
7. A method as recited in claim 1 wherein the temperature of said catalyst beds is in the range of 90 to 135°C.
8. A method as recited in claim 1 wherein the step of recycling said second column net overhead stream comprises recycling below said catalyst bed.
9. A method as recited in claim 1 wherein the step of recycling said second column net overhead stream comprises recycling above said catalyst bed.
10. A method as recited in claim 8 and further including the step of preheating said second column net overhead before recycling to said first column by heat exchange with said second column gross overhead thereby cooling and partially condensing said second column gross overhead.
11. A method as recited in claim 10 wherein said preheated second column net overhead is further preheated by an external heat stream.

12. A method as recited in claim 9, wherein the step of recycling said second column net overhead stream further includes the step of cooling said second column net overhead stream.

13. A method as recited in claim 1 wherein said first column reflux stream is preheated by heat exchange with said first column gross overhead stream whereby a greater quantity of the heat contained in said first column gross overhead stream can be cooled to recover heat value before the gross overhead stream is finally cooled against ambient temperature cooling medium.

14. A method as recited in claim 1 wherein said cooled first column gross overhead stream is further cooled by ambient temperature cooling.

15. A method of processing a cracked gas feed stream containing hydrogen, methane, ethylene, propylene and other C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub> and C<sub>6</sub> and heavier hydrocarbons including unsaturated hydrocarbons to separate said ethylene and propylene from at least some of said other hydrocarbons and to hydrogenate at least some of said other unsaturated hydrocarbons without hydrogenating ethylene and propylene comprising the steps of:

- a. introducing said feed stream into a catalytic distillation hydrogenation column operating at a first pressure and containing a hydrogenation catalyst and fractionation zones whereby at least a portion of said other unsaturated hydrocarbons are hydrogenated;
- b. separating a net overhead stream containing ethylene, propylene and other C<sub>2</sub> to C<sub>4</sub> hydrocarbons and a selected amount of C<sub>5</sub> hydrocarbons;

- c. separating a first bottoms stream containing said C<sub>6</sub> and heavier hydrocarbons and a portion of said C<sub>5</sub> and lighter hydrocarbons and maintaining said first bottoms stream at a temperature less than 200°C;
- d. introducing said first bottoms stream into a fractionation column operating at a second pressure lower than said first pressure;
- e. separating a net bottoms stream containing said C<sub>6</sub> and heavier hydrocarbons and a selected portion of said C<sub>5</sub> hydrocarbons and maintaining said net bottoms stream at a temperature below 200°C;
- f. separating a fractionation column net overhead containing portions of said C<sub>6</sub> and heavier hydrocarbons and portions of said C<sub>5</sub> and lighter hydrocarbons; and
- g. recycling said fractionation column net overhead stream to said catalytic distillation hydrogenation column.

16. A method as recited in claim 15 wherein the temperature of said first bottoms stream and said net bottoms stream are less than 160°C.

17. A method as recited in claim 15 wherein said first and second columns are operated as depentanizers and said selected amount of C<sub>5</sub> hydrocarbons in said net bottoms stream from said second column is less than 1%.

18. A method as recited in claim 17 wherein said first column is operated at a pressure in the range of 14 to 20 kg/cm<sup>2</sup> and said second column is operated at a pressure in the range of 4 to 10 kg/cm<sup>2</sup>.

19. A method as recited in claim 15 wherein said first and second columns are operated as debutanizers and said selected amount of C<sub>4</sub> hydrocarbons in said net bottoms stream is less than 1%.

20. A method as recited in claim 19 wherein said first column is operated at a pressure in the range of 28 to 43 kg/cm<sup>2</sup> and said second column is operated at a pressure in the range of 5 to 14 kg/cm<sup>2</sup>.

21. A method as recited in claim 15 wherein the temperature of said catalyst beds is in the range of 90 to 135°C.